ABSTRACT

A process for inducing direct somatic embryogenesis and secondary embryogenesis in monocotyledonous plant cells and rapidly regenerating fertile monocotyledonous plants is provided. In a first step, embryogenic monocotyledonous plant cells are cultured under conditions conducive to direct formation of primary embryos without an intervening callus stage, at least until at least one primary embryo reaches the globular developmental stage and no longer than the coleoptilar stage. In a second step, one or more primary embryos from the first step are cultured under conditions conducive to induction of secondary embryo formation, until secondary embryogenesis is detected. In a third step, one or more secondary embryos from the second step are cultured under conditions conducive to regeneration of plantlets from the secondary embryos. Also provided is a process for inducing direct somatic embryogenesis in monocotyledonous plant cells and rapidly regenerating fertile monocotyledonous plants, without secondary embryogenesis. In a first step, embryogenic monocotyledonous plant cells are cultured under conditions conducive to direct formation of primary embryos without an intervening callus stage, at least until at least one primary embryo reaches the globular developmental stage. In a second step, one or more primary embryos from the first step are cultured under conditions conducive to regeneration of plantlets from the primary embryos. Also provided is a process for inducing direct somatic embryogenesis and organogenesis in monocotyledonous plant cells and rapidly regenerating fertile monocotyledonous plants. Globular-stage embryos obtained by this same method for direct somatic embryogenesis are cultured under conditions conducive to induction of organogenesis, or until adventitious shoots are detected. One or more of the new shoots are then cultured under conditions conducive to regeneration of plantlets. Also provided is a process for inducing somatic embryogenesis in monocotyledonous callus cells, suspension cells, or microspore-derived embryos, and rapidly regenerating fertile monocotyledonous plants. In a first step embryogenic monocotyledonous callus cells, suspension cells or microspore-derived embryos are cultured in or on a culture medium comprising auxin, cytokinin, and polyamine in amounts effective to cause induction of embryo formation, the cytokinin being present in greater proportion than the auxin, at least until at least one embryo reaches the globular developmental stage. In a second step, one or more globular-stage embryos from the first step are cultured under conditions conducive to regeneration of plantlets from the globular-stage embryos. Fertile monocotyledonous plants produced according to the processes of the invention are also provided.